UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/739,087	12/16/2000	Furqan Zafar Shaikh	200-0550	3248

7590 07/21/2003

ERNEST E. HELMS
DYKEMA GOSSETT PLLC
39577 WOODWARD AVENUE
SUITE 300
BLOOMFIELD HILLS, MI 48304

EXAMINER	
FLETCHER III, WILLIAM P	
ART UNIT	PAPER NUMBER
1762	

DATE MAILED: 07/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/739,087	Applicant(s) SHAIKH ET AL.	
	Examiner William P. Fletcher III	Art Unit 1762	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 April 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disp sition of Claims

4)☒ Claim(s) *1-4,6,7,9 and 20-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4,6,7,9 and 20-24* is/are rejected.

7)☒ Claim(s) *1* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 January 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 30 January 2003 (paper no. 9) has been entered.

Response to Arguments

2. Applicant's arguments, see p. 3, 4th full paragraph, filed 30 January 2003 (paper no. 9), with respect to the rejections of claims 20, 21, and 23 under 35 U.S.C. 112, 1st Paragraph, have been fully considered and are persuasive. The rejections of these claims has been withdrawn.

3. Applicant's arguments with respect to the physical arrangement of applicant's process, filed 30 January 2003 (paper no. 9), have been fully considered but they are not persuasive. Applicant contends that the gas-dynamic cold spraying apparatus of Alkhimov would not fit within a cylinder of 3.5 to 4.5 inches diameter, which is typical of most automotive vehicle engines.

Applicant provided a declaration by one of the inventors to this effect. The declaration is not persuasive in light of the other exhibits provided by applicant. Specifically, applicant's Exhibit 2 states that a circular gas-dynamic cold spray nozzle has an exit diameter of 5 mm (0.2

in) and a rectangular nozzle has an exit geometry of 2 mm (0.08 in) x 10 mm (0.4 in). All of these dimensions are significantly smaller than the range of 3.5 to 4.5 inches and would, therefore, appear to comfortably fit inside a cylinder bore. The overall length of the nozzle and the lateral feeder mechanism, dimensions of which are not specified, would not appear to effect the diameter of the nozzle. Further, the size of other portions of the apparatus, apart from the nozzle, would not appear to effect whether or not the *nozzle* may be inserted, which is really what's important since the nozzle is the only portion of the apparatus that needs to be inserted into the cylinder bore. As to the photographs of the gas-dynamic cold spray apparatus in the Exhibits, no specific dimensions are given and the nozzles are not shown in relation to a cylinder bore. It is impossible to conclude from these photos that "the nozzle unit is of such a size that it cannot be fitted within a cylinder of a conventional automotive engine." Consequently, while Dr. Pan's declaration states that he was unable to find a gas-dynamic cold spray mechanism which can be inserted into a 3.5 to 4.5 inches diameter cylinder, applicant's exhibits suggest otherwise.

4. Applicant's arguments with respect to the insertion of two or more spray guns (see amended claims 1 and 24) have been considered but are moot in view of the new ground(s) of rejection.

Drawings

5. The corrected or substitute drawings were received on 06 February 2003 (paper no. 9). These drawings are acceptable.

Claim Objections

6. Claim 1 is objected to because of the following informalities: "at an angle at 30°" should, apparently, read "at an angle of 30°." Appropriate correction is required.

Claim Rejections - 35 USC § 112

7. The rejections under 35 USC 112, 1^{st} Paragraph, set-forth in paper no. 8 are hereby withdrawn.

8. The rejections of claims 20, 21, and 23 under 35 U.S.C. 112, 2^{nd} Paragraph, set-forth in paper no. 8 are hereby withdrawn.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 1-23 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 recites "said nozzle" in line 6 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim 22 recites the limitations "said first material" and "said second material." There is insufficient antecedent basis for this limitation in the claim. This claim is further indefinite as to which materials are being utilized since the specification discloses a size range of 10-22 microns

for particles of copper or copper alloy, and a range of 1-50 microns for particles of the wear-resistant material.

Claim Rejections - 35 USC § 103

11. The rejections under 35 U.S.C. 103 set-forth in paper no. 8 are hereby withdrawn. New grounds of rejection are set-forth below.

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

14. Claims 1-4, 6, 7, 9, and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Palazzolo et al. (US 5,691,004) in view of Alkhimov et al. (US 5,302,414), Shepard (US 2,588,422), and Marantz et al. (US 5,714,205).

With respect to claims 1, 6, 7, and 9, Palazzolo teaches a process of lining a cylinder bore of an aluminum engine block in which the cylinder bore is sprayed with a lining material of various metals that are different from the material of the engine block [abstract]. The lining material is applied by thermal spraying [abstract]. This thermal spraying is carried-out by a powder plasma spray technique [c. 4, ll. 55-56].

Palazzolo does not teach that the lining is applied using a gas-dynamic cold spray, that the spray comes from nozzles having unified, up-and-down relative movement with the engine block, or that the nozzles are at an angle of 30° plus or minus 15° with a surface the cylinder bores.

Alkhimov teaches a cold gas-dynamic spraying process for applying a coating to an article [abstract]. This process directs a jet of powder of a metal, alloy, or a mechanical mixture of the a metal and an alloy, against an article to deposit the coating [abstract]. Alkhimov teaches that this cold gas-dynamic spraying process eliminates damage to the substrate and poor coating characteristics associated with powder plasma thermal spraying techniques [c. 1, l. 44-c. 4, l. 5].

Because both Palazzolo and Alkhimov teach the spray application of powders of metals and/or alloys to substrates, and because Alkhimov teaches that the cold gas-dynamic spraying process is superior to powder plasma thermal spraying, it would have been obvious to one of ordinary skill, at the time the invention was made, to modify the process of Palazzolo so as to deposit the lining material by the cold gas-dynamic spraying technique of Alkhimov. One of

ordinary skill in the art would have been motivated to do so by the desire and expectation of successfully depositing a lining material of superior quality without damaging the cylinder bore surface.

Shepard teaches a process similar to that of Palazzolo in which a lining material is applied to an aluminum cylinder bore by thermal spraying [c. 6, Example]. The spray nozzle is advanced co-axially into the cylinder, and the nozzle sprays at an angle of approximately 40° with respect to the cylinder bore [c. 6, Example]. The desired thickness may be applied in more than one pass [c. 6, Example].

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the process of Palazzolo in view of Alkhimov so as to apply the lining material according to the process of Shepard described above. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of successfully coating the cylinder with the lining material.

The nozzle angle of 40° taught by Shepard falls within the claimed range of 30° plus or minus 15°. It is the examiner's position that, advancing the nozzle co-axially into the cylinder reads on having up-and-down relative movement with the engine block. Further, it is the examiner's position that Shepard's teaching of co-axially positioning the nozzle reads on the nozzle's being positioned along a longitudinal center axis of said cylinder. Finally, it is the examiner's position that modifications necessary to the apparatus of Alkhimov, such as those required to angle the nozzle to spray at approximately 40°, would have been well-within the level of skill of one of ordinary skill in the art.

Marantz teaches a process similar to that of Palazzolo in which a lining material is applied to a cylinder bore by thermal spraying [c. 1, l. 66-c. 2, l. 17]. As illustrated best in Fig. 5, a plurality of cylinders (in Fig. 5, 4 cylinders) are coated simultaneously by spraying from nozzles having coaxial, reciprocating, unified, up-and-down movement with respect to the engine block. As is readily apparent, such an arrangement is significantly more efficient when compared to the one-cylinder-at-a-time coating process of Palazzolo. Consequently, it would have been obvious to one of ordinary skill in the art to modify the process of Palazzolo in view of Alkhimov and Shepard so as to coat a plurality of cylinder bores simultaneously by spraying from nozzles having coaxial, reciprocating, unified, up-and-down movement with respect to the engine block, as taught by Marantz. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of improving the efficiency of the coating process by coating a plurality of cylinders at once, as opposed to one cylinder at a time.

The examiner notes that Shepard teaches that the cylinder bore is rotated while the liner material is applied from the nozzle. Obviously, rotation of the cylinder bores (and, by extension, the engine block) would be quite impossible where a plurality of nozzles are inserted into a plurality of bores simultaneously. Marantz teaches that common prior art processes for lining cylinder bores involve either rotation of the bores or rotation of the nozzles [see c. 1]. Consequently, it would have been obvious to one of ordinary skill in the art to further modify the process of Palazzolo in view of Alkhimov, Shepard, and Marantz so as to rotate the nozzles in the bores as opposed to the bores around the nozzles. One of ordinary skill would have recognized, from the teaching of Marantz, that both are obvious variations, one of the other, giving identical results: uniformly coating the inside of the cylinder bores.

With respect to claim 2, Palazzolo further teaches that the process coats the cylinder bore with a first and second lining material [abstract]. The first lining material may be 95% bronze [c. 4, ll. 50-54]. Bronze is an alloy of copper. The second lining material may be ferritic stainless steel mixed with nickel-encapsulated boron nitride [c. 5, ll. 8-15].

Palazzolo does not explicitly state that the second has a heat transfer resistance that is greater than the first material.

As noted above, Shepard teaches a process similar to that of Palazzolo in which a first lining material and a second lining material are thermal spray-applied to an aluminum cylinder bore [c. 6, Example]. More specifically, Shepard teaches that, where a particular wear- and corrosion-resistance are desired, stainless steel may be the second lining material [c. 5, ll. 23-27].

It would have been obvious to one of ordinary skill in the art to modify the process of Palazzolo in view of Alkhimov, Shepard, and Marantz, so as to apply, as the second lining material, stainless steel. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of successfully depositing a wear- and corrosion-resistant lining material.

Applicant, at p. 6, l. 14-p.7, l. 15 of the specification, discloses that a suitable combination of first and second material layers, in which the second material layer has a higher heat transfer resistance than the first material layer, is copper alloy as the first material layer and stainless steel as the second material layer. Absent clear and convincing evidence to the contrary, it is the examiner's position that, in teaching the same material layers as those disclosed by applicant, Palazzolo in view of Alkhimov, Shepard, and Marantz inherently teach coating the

cylinder bore with two material layers, with the heat transfer resistance of the second material layer being greater than that of the first material layer.

With respect to claim 3, Palazzolo further teaches that the process coats the cylinder bore with a first and a second lining material [abstract]. The first lining material may be 95% bronze [c. 4, ll. 50 – 54]. Bronze is an alloy of copper. The second lining material is ferritic stainless steel mixed with nickel-encapsulated boron nitride [c. 5, ll. 8 – 15].

Palazzolo does not explicitly state that the adhesion of the first material layer to the aluminum engine block is greater than that of the second material layer, or that the material hardness of the second material layer is greater than that of the first material layer.

Nevertheless, Palazzolo teaches that the first material layer is coated as a bond coat because of its metallurgical affinity for the substrate [c. 4, ll. 50 – 54]. It is the examiner's position that, in the process of Palazzolo, the first material layer inherently has a greater adhesion to the aluminum engine block as attested to by it's being used as a bond coat.

Further, bronze is a soft alloy, certainly softer than ferritic stainless steel mixed with nickel-encapsulated boron nitride. It is the examiner's position that Palazzolo also, therefore, teach that the material hardness of the second lining material is greater than that of the first.

In the alternative, Shepard teach a process similar to that of Palazzolo in which a first and second lining material are thermal spray-applied to an aluminum cylinder bore [c. 6, Example]. More specifically, they teach that where a particular wear- and corrosion-resistance are desired, stainless steel may be the second lining material [c. 5, ll. 23 – 27].

It would have been obvious to one of ordinary skill in the art to apply, as the second lining material, stainless steel. One of ordinary skill in the art would have been motivated to do so by the expectation of successfully depositing a wear- and corrosion-resistant lining material.

Applicant, at p. 6, l. 14-p.7, l. 15 of the specification, discloses that a suitable combination of first and second material layers, in which the first material layer has a greater adhesion to the aluminum engine block that the second material layer, and the second material layer has a greater material hardness than the first material layer, is a copper alloy as the first material layer and stainless steel as the second material layer. Absent clear and convincing evidence to the contrary, it is the examiner's position that, in teaching the same material layers as those disclosed by applicant, Palazzolo in view of Alkhimov, Shepard, and Marantz inherently teach coating the cylinder bore with two material layers, with the adhesion of the first material layer to the aluminum engine block greater than the second material layer, and the material hardness of the second material layer greater than the first material layer.

With respect to claim 4, Palazzolo does not explicitly state that the adhesion of the first material layer to the aluminum engine block is greater than that of the second material layer, or that the material hardness of the second material layer is greater than that of the first material layer.

Applicant, on p. 6, l. 14-p. 7, l. 15 of the specification, discloses that a suitable combination of first and second material layers, in which the first material layer has a greater adhesion to the aluminum engine block that the second material layer, and the second material layer has a greater material hardness than the first material layer, is a copper alloy as the first material layer and stainless steel as the second material layer. Absent clear and convincing

evidence to the contrary, it is the examiner's position that, in teaching the same material layers as those disclosed by applicant, Palazzolo in view of Alkhimov, Shepard, and Marantz inherently teach coating the cylinder bore with two material layers, with the adhesion of the first material layer to the aluminum engine block greater than the second material layer, and the material hardness of the second material layer greater than the first material layer.

With respect to claim 22, Alkhimov teaches that the particle size of the materials deposited is between about 1 and about 50 microns [abstract]. This overlaps both ranges claimed by applicant. In the case where claimed ranges overlap or lie inside ranges disclosed by the prior art, a *prima facie* case of obviousness exists. Consequently, it would have been obvious to one of ordinary skill in the art to deposit the first and second material utilizing a material size for each between about 1 and 50 microns, as suggested by Alkhimov.

15. Claims 20, 21, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Palazzolo et al. (US 5,691,004) in view of Alkhimov et al. (US 5,302,414), Shepard (US 2,588,422), and Marantz et al. (US 5,714,205), as applied to claim 1 above, in further view of Gorynin et al. (US 5,362,523).

With respect to claims 20 and 21, Palazzolo, Alkhimov, Shepard, and Marantz teach all the limitations of these claims described above, including coating a first material with a lower thermal resistance and wear resistance than a second material (see the rejections of claims 2-4).

None of the cited references teach initially coating the cylinder bore with a first material, then with a gradient of the first material and a second material, followed by the second material.

Gorynin teaches that stable interfaces between two materials having differences in their physical properties (specifically, thermal expansion coefficients) may be achieved by forming a compositional gradient of the materials [c. 1, ll. 10-23]. Specifically, thermal shock that leads to delamination or spalling of coating layers is avoided by coating a film that is initially 100% of a first material and grades through the thickness profile of the deposited layer to 100% of a second material [see Fig. 4]. While Gorynin particularly suggests a metal/metal-oxide graded film, it is clear that such a gradient may be advantageously produced from two other materials with different physical properties, such as to metals or alloys.

In the rejection of claims 2-4 above, it was established that Palazzolo in view of Alkhimov, Shepard, and Marantz, teach the deposition of first and second materials with different thermal resistance. Consequently, it would have been obvious to one of ordinary skill in the art to deposit a graded layer of first and second materials, as suggested by Gorynin. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of preventing delamination and spalling of the coating due to thermal shock.

The examiner notes that Gorynin teaches powder plasma spraying the first and second materials. Again, as noted above, Alkhimov teaches the advantages of gas-dynamic cold spraying over powder plasma thermal spraying. It is the examiner's position that modifications necessary to the apparatus of Alkhimov, such as those required to provide for controlled, metered mixing of the first and second materials during deposition, would have been well-within the level of skill of one of ordinary skill in the art.

With respect to claim 23, Alkhimov teaches that the particle size of the materials deposited is between about 1 and about 50 microns [abstract]. This overlaps both ranges claimed

by applicant. In the case where claimed ranges overlap or lie inside ranges disclosed by the prior art, a *prima facie* case of obviousness exists. Consequently, it would have been obvious to one of ordinary skill in the art to deposit the first and second material utilizing a material size for each between about 1 and 50 microns, as suggested by Alkhimov.

16. Claim 24 is rejected under 35 USC 103(a) as being unpatentable over Palazzolo et al. (US 5,691,004) in view of Alkhimov et al. (US 5,302,414), Shepard (US 2,588,422), Marantz et al. (US 5,714,205), and Gorynin et al. (US 5,362,523).

Palazzolo teaches a process of lining a cylinder bore of an aluminum engine block in which the cylinder bore is sprayed with a lining material of various metals that are different from the material of various metals that are different from the material of the engine block [abstract]. The lining material is applied by thermal spraying [abstract]. This thermal spraying is carried-out by a powder plasma spray technique [c. 4, ll. 55-56].

Palazzolo does not teach that the lining is applied using a gas-dynamic cold spray; that the spray comes from nozzles having unified, up-and-down relative movement with the engine block; that the nozzles are at an angle of 30° plus or minus 15° with a surface the cylinder bores; or that the process includes initially coating the bores with a copper material, then coating the bores with a blend gradient of copper and a wear material, and then coating the bores with the wear material.

Alkhimov teaches a cold gas-dynamic spraying process for applying a coating to an article [abstract]. This process directs a jet of powder of a metal, alloy, or a mechanical mixture of the a metal and an alloy, against an article to deposit the coating [abstract]. Alkhimov teaches

that this cold gas-dynamic spraying process eliminates damage to the substrate and poor coating characteristics associated with powder plasma thermal spraying techniques [c. 1, l. 44-c. 4, l. 5].

Because both Palazzolo and Alkhimov teach the spray application of powders of metals and/or alloys to substrates, and because Alkhimov teaches that the cold gas-dynamic spraying process is superior to powder plasma thermal spraying, it would have been obvious to one of ordinary skill, at the time the invention was made, to modify the process of Palazzolo so as to deposit the lining material by the cold gas-dynamic spraying technique of Alkhimov. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of successfully depositing a lining material of superior quality without damaging the cylinder bore surface.

Shepard teaches a process similar to that of Palazzolo in which a lining material is applied to an aluminum cylinder bore by thermal spraying [c. 6, Example]. The spray nozzle is advanced co-axially into the cylinder, and the nozzle sprays at an angle of approximately 40° with respect to the cylinder bore [c. 6, Example]. The desired thickness may be applied in more than one pass [c. 6, Example].

It would have been obvious to one of ordinary skill in the art, at the time the invention was made, to modify the process of Palazzolo in view of Alkhimov so as to apply the lining material according to the process of Shepard described above. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of successfully coating the cylinder with the lining material.

The nozzle angle of 40° taught by Shepard falls within the claimed range of 30° plus or minus 15°. It is the examiner's position that, advancing the nozzle co-axially into the cylinder

reads on having up-and-down relative movement with the engine block. Further, it is the examiner's position that Shepard's teaching of co-axially positioning the nozzle reads on the nozzle's being positioned along a longitudinal center axis of said cylinder. Finally, it is the examiner's position that modifications necessary to the apparatus of Alkhimov, such as those required to angle the nozzle to spray at approximately 40°, would have been well-within the level of skill of one of ordinary skill in the art.

Marantz teaches a process similar to that of Palazzolo in which a lining material is applied to a cylinder bore by thermal spraying [c. 1, l. 66-c. 2, l. 17]. As illustrated best in Fig. 5, a plurality of cylinders (in Fig. 5, 4 cylinders) are coated simultaneously by spraying from nozzles having coaxial, reciprocating, unified, up-and-down movement with respect to the engine block. As is readily apparent, such an arrangement is significantly more efficient when compared to the one-cylinder-at-a-time coating process of Palazzolo. Consequently, it would have been obvious to one of ordinary skill in the art to modify the process of Palazzolo in view of Alkhimov and Shepard so as to coat a plurality of cylinder bores simultaneously by spraying from nozzles having coaxial, reciprocating, unified, up-and-down movement with respect to the engine block, as taught by Marantz. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of improving the efficiency of the coating process by coating a plurality of cylinders at once, as opposed to one cylinder at a time.

Palazzolo further teaches that the process coats the cylinder bore with a first and second lining material [abstract]. The first lining material may be 95% bronze [c. 4, ll. 50-54]. Bronze is an alloy of copper.

As noted above, Shepard teaches a process similar to that of Palazzolo in which a first lining material and a second lining material are thermal spray-applied to an aluminum cylinder bore [c. 6, Example]. More specifically, Shepard teaches that, where a particular wear- and corrosion-resistance are desired, stainless steel may be the second lining material [c. 5, ll. 23-27].

It would have been obvious to one of ordinary skill in the art to modify the process of Palazzolo in view of Alkhimov, Shepard, and Marantz, so as to apply, as the second lining material, stainless steel. One of ordinary skill in the art would have been motivated to do so by the desire and expectation of successfully depositing a wear- and corrosion-resistant lining material.

Gorynin teaches that stable interfaces between two materials having differences in their physical properties (specifically, thermal expansion coefficients) may be achieved by forming a compositional gradient of the materials [c. 1, ll. 10-23]. Specifically, thermal shock that leads to delamination or spalling of coating layers is avoided by coating a film that is initially 100% of a first material and grades through the thickness profile of the deposited layer to 100% of a second material [see Fig. 4]. While Gorynin particularly suggests a metal/metal-oxide graded film, it is clear that such a gradient may be advantageously produced from two other materials with different physical properties, such as to metals or alloys.

In the rejection of claims 2-4 above, it was established that Palazzolo in view of Alkhimov, Shepard, and Marantz, teach the deposition of first and second materials with different thermal resistance. Consequently, it would have been obvious to one of ordinary skill in the art to deposit a graded layer of copper and a wear-resistant material (specifically nickel-encapsulated cubic boron nitride or stainless steel), as suggested by Gorynin. One of ordinary

skill in the art would have been motivated to do so by the desire and expectation of preventing delamination and spalling of the coating due to thermal shock.

The examiner notes that Gorynin teaches powder plasma spraying the first and second materials. Again, as noted above, Alkhimov teaches the advantages of gas-dynamic cold spraying over powder plasma thermal spraying. It is the examiner's position that modifications necessary to the apparatus of Alkhimov, such as those required to provide for controlled, metered mixing of the first and second materials during deposition, would have been well-within the level of skill of one of ordinary skill in the art.

The examiner notes that Shepard teaches that the cylinder bore is rotated while the liner material is applied from the nozzle. Obviously, rotation of the cylinder bores (and, by extension, the engine block) would be quite impossible where a plurality of nozzles are inserted into a plurality of bores simultaneously. Marantz teaches that common prior art processes for lining cylinder bores involve either rotation of the bores or rotation of the nozzles [see c. 1]. Consequently, it would have been obvious to one of ordinary skill in the art to further modify the process of Palazzolo in view of Alkhimov, Shepard, and Marantz so as to rotate the nozzles in the bores as opposed to the bores around the nozzles. One of ordinary skill would have recognized, from the teaching of Marantz, that both are obvious variations, one of the other, giving identical results: uniformly coating the inside of the cylinder bores.

Conclusion

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to William Phillip Fletcher III whose telephone number is (703) 308-7956. The examiner can normally be reached on Monday through Friday, 9 AM to 5 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive P. Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

William Phillip Fletcher III
Patent Examiner
United States Patent & Trademark Office
Group Art Unit 1762

wpf
May 28, 2003

SHRIVE P. BECK
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700